

CBA Green Søderberg Technology

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2.Reduction Process Coordinator

3 Reduction Sr. Engineer

4 Reduction Production Supervisor

5.Reduction Sr. Process Technician

6.Reduction Pl. Process Technician

7 Reduction Production Coordinator

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Abstract

Due to the world environmental challengers to decrease the carbon footprint and increase sustainability of the operations combined with increased productivity, CBA is upgrading the smelter technology to so called Green Søderberg (GS). This improvement proposes a change in the way of feeding alumina into the pots, shifting from side break to point feeding. This change in technology enhances current efficiency and furthermore decreases the emissions of greenhouse gases (from anode effects), particulate and fluoride emissions. CBA started this project in 2019, with a test on 36 pots to study and prove the gains. A multidisciplinary team worked in the mechanical, electrical and process control areas. The outstanding results of the test group such as a decrease of 70 % of anode effect frequency and more than 1 % current efficiency increase made possible the expansion of the project. The forecast is that in 2021 another 36 pots will be converted. It is noteworthy that during the conversion/start-up of the first 36 pots, it was found out that the future conversion of the pots can be made without shutting down the potline. This decreases the disturbance during the conversion and improves the speed of conversion. Furthermore, the production loss will be minimized because of this new procedure. When all pots have been converted (more than 1200 pots) to the new system, the wet scrubber systems will be replaced by a dry scrubber, eliminating the need for water in the process and secondary by products.

Keywords: Green Soderberg technology, Carbon footprint, Point feeder, Anode effect frequency.

1. Introduction

Companhia Brasileira de Alumínio (CBA) is located in Alumínio near São Paulo since 1955, being a fully integrated and sustainable aluminum producer. It has an installed capacity to produce 100 % of energy coming from its own hydroelectric plants, CBA mines bauxite, transforms it into primary aluminum (ingots, slabs, billets and others) and transformed products (caster rolls, sheets, sheets, extruded profiles) [1].

The current aluminum production use vertical stud Søderberg (VSS) technology pots with side breakage and over the years it has undergone some expansion and modernization processes. These processes included the implementation of wet HF scrubbing system combined with the gas

entrapment of 5 potrooms structures between 2002 and 2011. The environmental license for the other two potroom allowed to operate without the wet HF scrubbing system until 2019.

Seeking to meet environmental requirements, reducing emissions and improving the working conditions of employees, after analyzing some options, it was decided to implement a point feeder system [2, 3] due to its low investment, better working environment, non-use of water, improved pot current efficiency and productivity. The first Soderberg with point feeders was installed in 2018.

2. Green Søderberg Project

Currently, CBA operates, in the municipality of Alumínio (SP), with 6 potrooms with Vertical Soderberg Stud (VSS) technology, whose feeding process for these tanks is carried out by lateral breakage, at intervals pre-defined throughout the day, using break equipment. During this operation, a large amount of oxide enters the pot, increasing the percentage of alumina in the bath to values close to 5.5 %. In addition to the impact on the stability of the pot, at the time of this activity there is a considerable particulate emission.

The Green Soderberg project, started in 2017, aims to automate the pot feeding process, thus reducing emissions from this process and promoting additional gains in efficiency and productivity. This feeding system was initially installed in 12 pilot pots, in potroom 3. This change in equipment allowed these pots to be fed by aluminum oxide and aluminum fluoride on a timely basis [1]. To make this improvement possible, bins were installed in the pot and a structure of cylinders breakers. Figure 1 depicts a schematic drawing of the feeding system in a single pot and where it will be assembled.

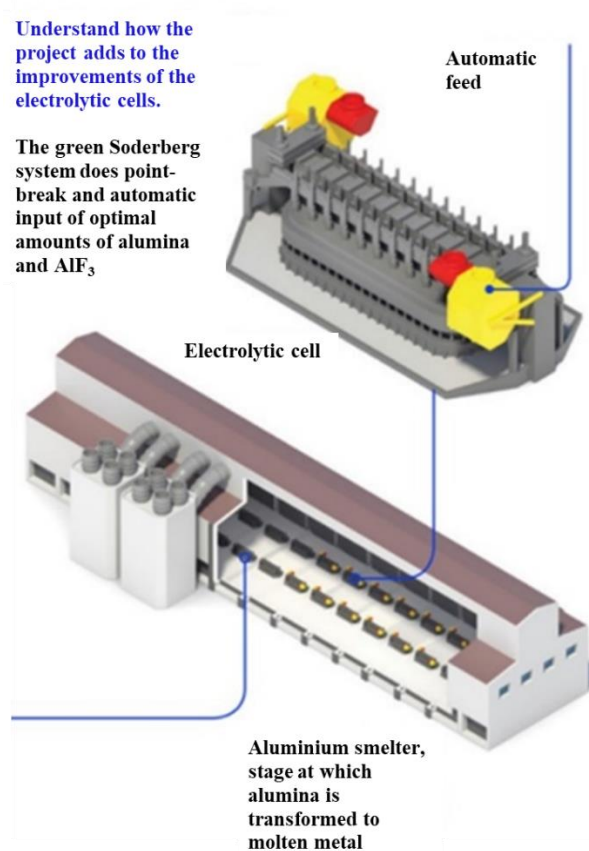


Figure 1. Schematic drawing of the point feeder pots.

2.1. Expansion

At the end of 2018, CBA completed another part of the project expansion to another 24 pots, totaling 36 pots converted with the point feeder system. Figure 2 shows the expansion pots.



Figure 2. Pilot test pots.

For this expansion there were several power interruptions and several pots were also cutout temporarily.

2.2. Hot Conversion

Based on the knowledge acquired with the conversion of the 36 pots, the hot conversion of two pots (616 and 617) was carried out. This allowed for no loss of production, as it was not necessary to cutout the pots to assemble the new system neither to have power interruptions for the line. Thus, all CBA pots will be converted into this format.

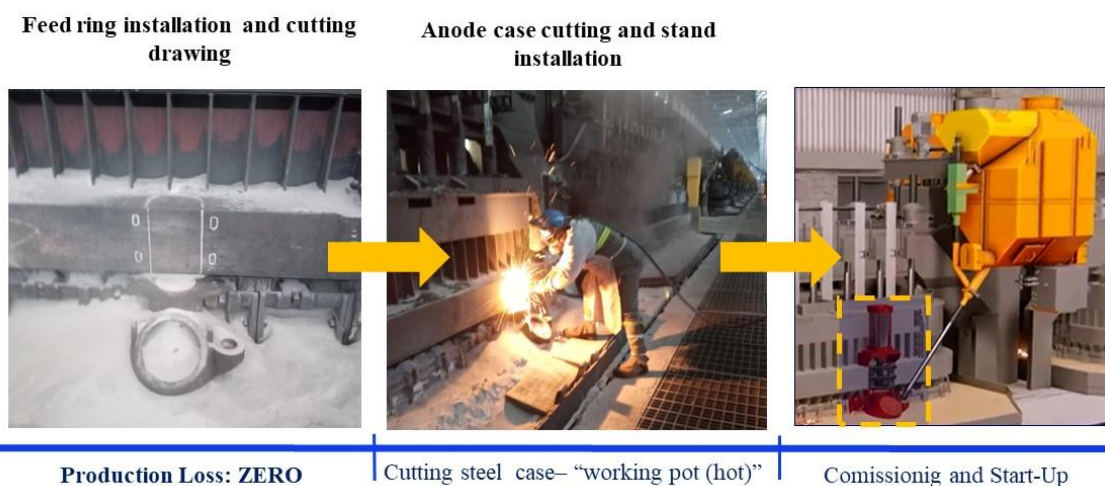


Figure 3. Hot conversion sequence.

3. Results and Discussion

3.1. Results 2018 (Pilot Test – 12 pots)

In the pilot test project, with the 12 pots, there was a period for adjusting the parameters that lasted until January 2019. The main issue was the high number and time of power interruptions to assemble the GS System. From then onwards, the frequency of anode effect was better than in the side break VSS pots, Figure 4 shows the results.

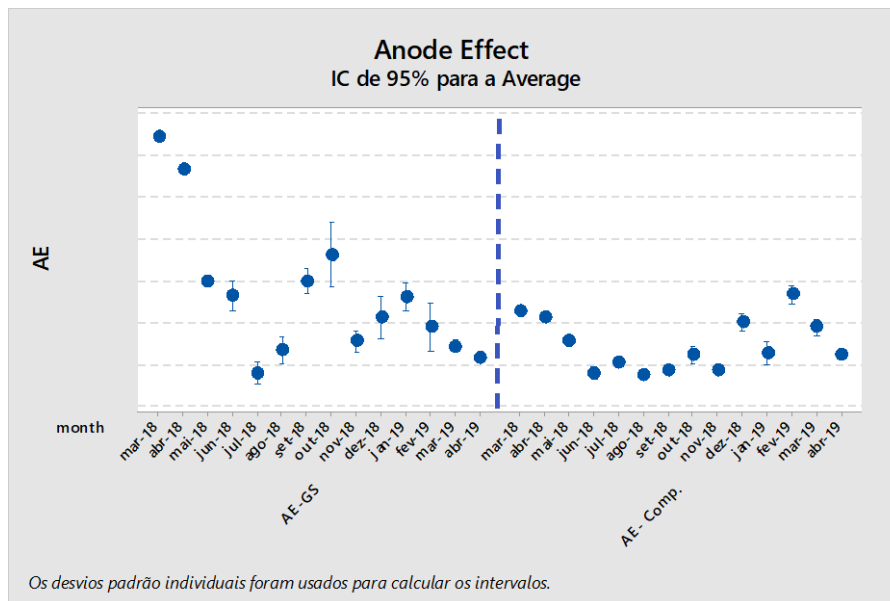


Figure 4. Anode effect comparison GS vs. Side break.

The project's pots also proved to be more efficient, as can be seen from the daily metal tapping per pot throughout the highlighted period Figure 5. There was an increase of 1.5 % in current efficiency (CE).

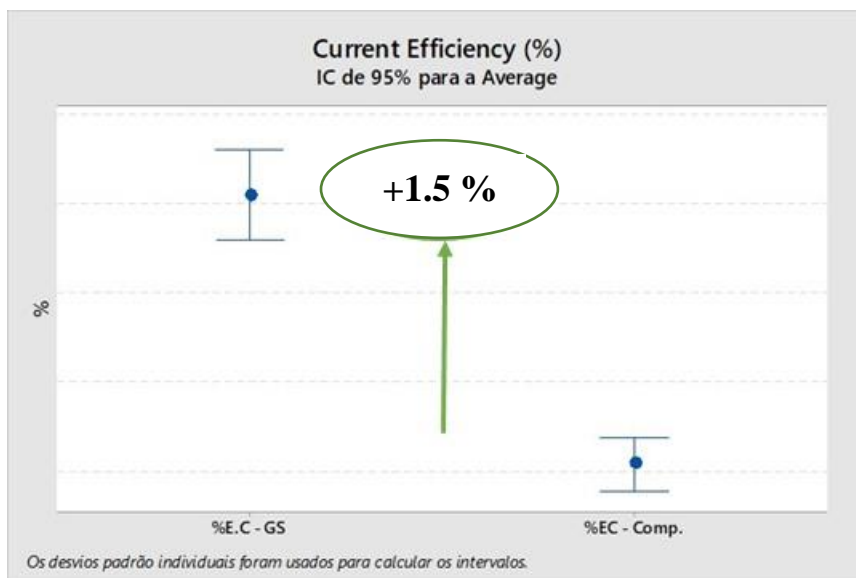


Figure 5. Increase in CE - GS vs. side break.

Because of the performance of the pots due to better alumina and AlF_3 feed control and stability of the pots, there was better paste consumption. Figure 6 shows the improvements in carbon paste consumption.

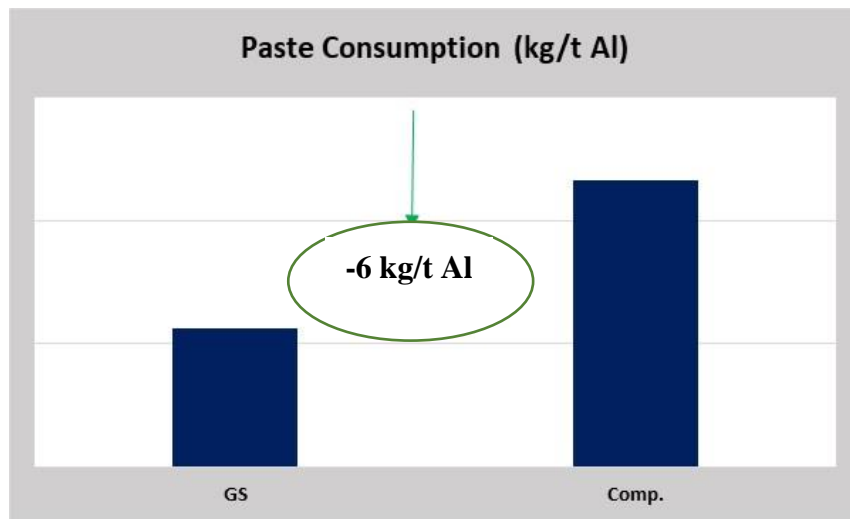


Figure 6. Decrease in paste consumption - GS vs. side break.

3.2 Results for 36 pots (from April 2019 to July 2021)

Considering the 36 pots converted to the point feeder system, there were significant improvements in the processes along the years. Figure 7 depicts the results.

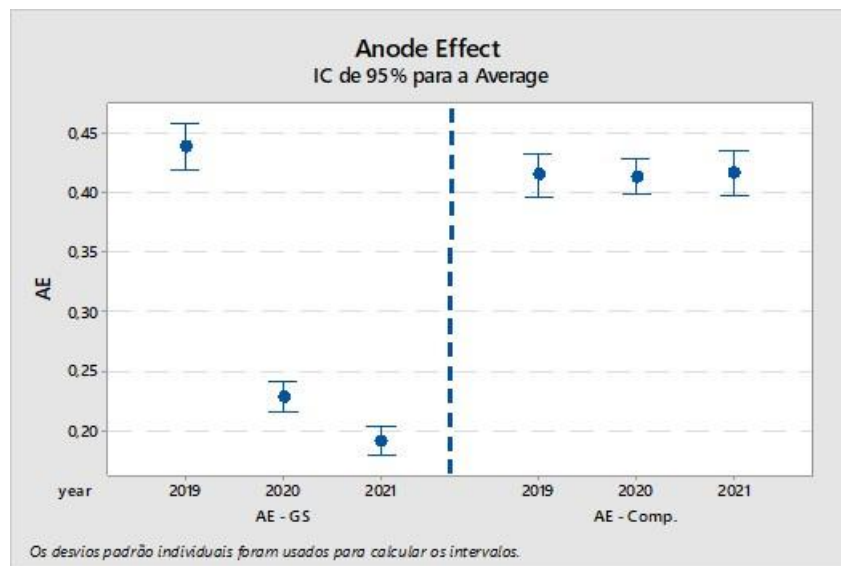


Figure 7. Decrease in anode effect frequency - GS vs. side break.

For current efficiency the analysis period was from May 2019 to July 2021, showing a gain of 0.85 % in current efficiency in GS pots in comparison with side break pots. This gain was concentrated in 2019 (Figure 8a). In 2021 this difference is +1.3 % of current efficiency in the GS pots (Figure 8b).

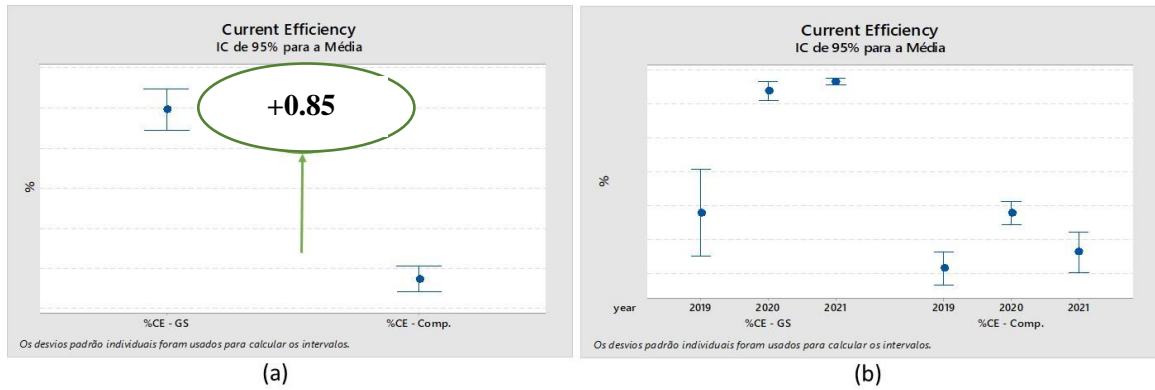


Figure 8. (a) Current efficiency in 2019 (b) evolution of the CE - GS vs. side break.

Paste consumption impacted by better productivity of converted pots, Figure 9.

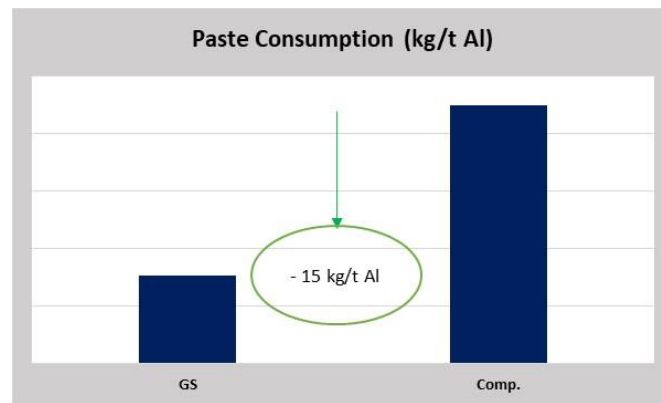
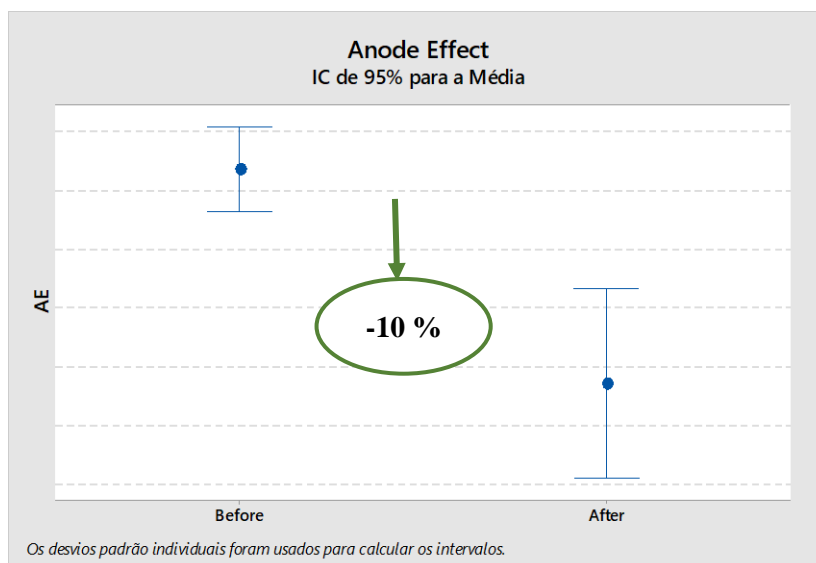
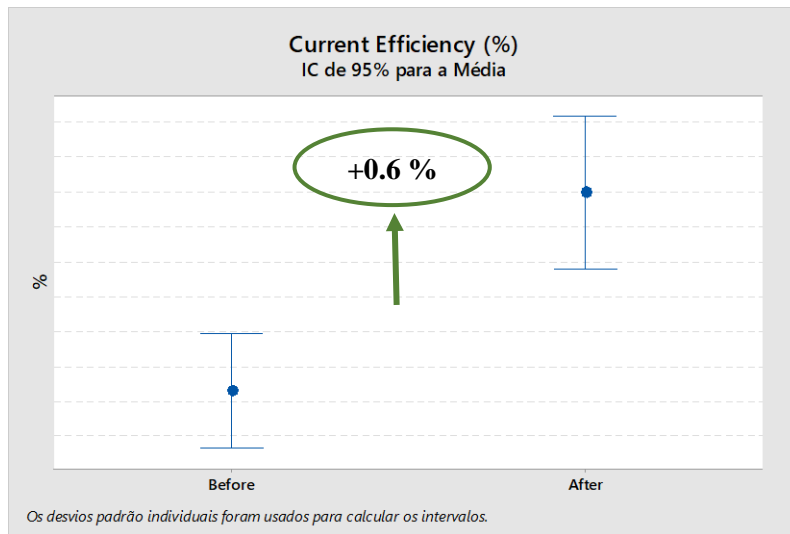


Figure 9. Decrease in Paste Consumption - GS vs. side break.

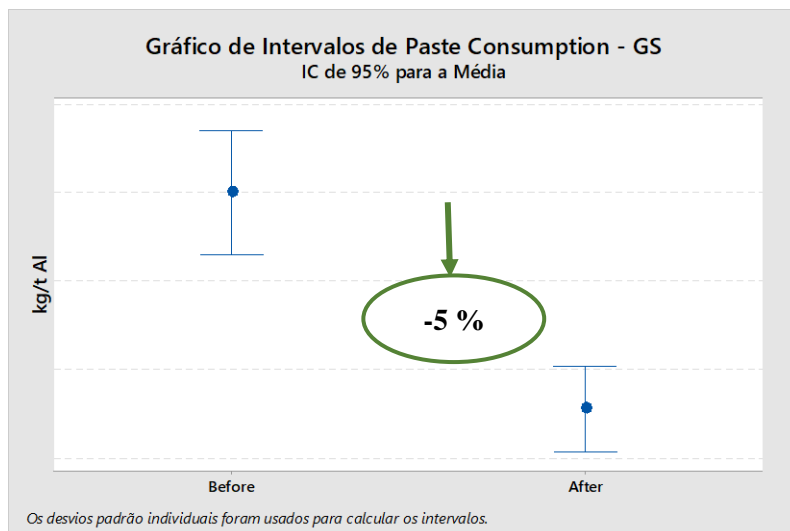
Another analysis performed on the 36 pots GS group was before (before implementation) and after (after implementation) for the same parameters presented before (AE, CE and Paste Consumptions) from the previous 12 months (before) and 12 months after. Figures 10, 11 and 12 shown the results.



Figures 10. Anode Effect before and after implementation



Figures 11. Current Efficiency before and after implementation



Figures 12. Paste Consumption before and after implementation

The summary and the schedule for the project is presented in Table 1. The first step now is to change the others 32 operating pots to point feeders than restart the others 78 cutout pots in 2022. After that complete all CBA by 2030, more than 1000 extra pots.

Table 1: Project Summary and Schedule

Parameter	Current	Future
Number of Al ₂ O ₃ feeders	2	2
Number of AlF ₃ feeders	2	2
Number of crust Breaks	2	2
Amperage (kA)	130.2	130.2
Number of Pots	36	150

Accounting for CE, paste consumption and anode effect frequency improvements there was a potential gain on CO_{2eq} when CBA will be fully converted by GS project. The potential calculated CO_{2eq}/t Al decrease is around 18 %.

4. Conclusions

The Green Søderberg project will not only meet all the Brazilian environmental requirements by reducing PFCs and HF emissions, but also improve the working conditions of employees in the potrooms. Furthermore, there are improvements of current and energy efficiency. The sooner CBA replaces the side break technology for point feeder technology the more benefits will be for the surrounding community will be achieved.

The point feeders were already proven technology in the prebaked anodes and is becoming a new reality for Søderberg pots. This change in technology will decrease the CO₂ footprint by more than 50 % from the current values.

5. References

1. Annual Report CBA, 2019.
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3. James H. Nordquist, Continuous ore feeder for Soderberg aluminium reduction cells, *WO Patent* 1992006228, filed Oct. 4, 1991, granted April 16, 1992.